





PREDATION OF *MYOTIS NIGRICANS* (CHIROPTERA: VESPERTILIONIDAE) BY *SPILOTES SULPHUREUS* (SQUAMATA: COLUBRIDAE) AND A REVISED LIST OF THE USE OF ROOFS AS FEEDING SITES BY NEOTROPICAL SNAKES

DEPREDACIÓN DE *MYOTIS NIGRICANS* (CHIROPTERA: VESPERTILIONIDAE) POR *SPILOTES SULPHUREUS* (SQUAMATA: COLUBRIDAE) Y UNA LISTA REVISADA DEL USO DE TECHOS COMO SITIOS DE ALIMENTACIÓN POR SERPIENTES NEOTROPICALES

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Received: 2024-02-04. Accepted: 2024-05-23. Published: 2024-07-09.

Editor: Ernesto Raya-García, México.

Resumen.— Reportamos el primer registro de depredación de un Murciélago Negruzco Común (*Myotis nigricans*) por una Serpiente Silbadora Gigante (*Spilotes sulphureus*), ocurrido en el techo de paja de la Estación Biológica Manu Learning Centre en la zona de amortiguamiento del Parque Nacional del Manu, Madre de Dios, Perú. Además, proporcionamos una breve y comparativa lista del uso observado de techos como sitios de alimentación en otras especies de serpientes neotropicales. Nuestra observación de *S. sulphureus*, junto con registros previos de serpientes encontradas cazando en los techos, resalta cómo los hábitats antropogénicos pueden brindar oportunidades de alimentación únicas y cómo algunas especies de serpientes se han adaptado para utilizarlas. Además, estas serpientes pueden desempeñar un papel en el control de plagas de especies que se sabe que son portadoras de enfermedades zoonóticas, como los murciélagos, proporcionando un servicio beneficioso para los humanos.

Palabras clave.— Dieta, murciélagos, Parque Nacional del Manu, serpientes, servicios del ecosistema.

Abstract.— We report the first record of predation of a Black Myotis (*Myotis nigricans*) by a Yellow-bellied Puffing Snake (*Spilotes sulphureus*), which occurred in the thatched roof of the Manu Learning Centre Biological Station in the buffer zone of the Manu National Park, Madre de Dios, Peru. Additionally, we provide a brief and comparative list of the observed use of roofs as feeding sites in other species of neotropical snakes. Our observation of *S. sulphureus*, along with previous records of snakes found hunting in roofs, highlights how anthropogenic habitats may provide unique feeding opportunities and how some species of snakes have adapted to utilise them. Furthermore, these snakes may play a role in pest control of species known to carry zoonotic diseases such as bats, providing a beneficial service to humans.

Keywords.— Bats, diet, ecosystem services, Manu National Park, snakes.

Across the Neotropics, especially in rural areas, snakes have been observed in the roofs of human buildings, sometimes utilising them for hunting due to the presence of prey species such as bats (Esbérard & Vrcibradic, 2007; Chávez-Arribasplata et al.,

2016). *Spilotes sulphureus* (Yellow-bellied Puffing Snake) is an arboreal snake species that is widely distributed throughout the Amazon region as well as the Brazilian Atlantic Forest (Andrade et al., 2017), in primary and secondary forest, plantations, and

human disturbed sites (Cunha & Nascimento, 1993; Martins & Oliveira, 1998). It is an active predator that has been recorded to feed on birds (eggs, nestlings, domestic and native adult birds) (Beebe, 1946; Rivas & Kane, 2003; Alves et al., 2005; Bernarde & Abe, 2010), bats (Rufino & Bernardi, 1999; Esbérard & Vrcibradic, 2007; Andrade et al., 2017), rodents (Cunha & Nascimento, 1993; Bocchiglieri & Gomes, 2019), lizards and amphibians (Marques et al., 2001; de Freitas, 2003).

The vespertilionid bat, *Myotis nigricans* (Black Myotis) has the widest geographic range and altitudinal distribution of its genus, extending from Mexico to northern Argentina, and from sea level to 3,150 m a.s.l. (Wilson & LaVal, 1974; Moratelli et al., 2011). This insectivorous bat is more common in disturbed areas, such as human buildings, than in primary forest (Wilson, 1971). Their predators include mammals, birds, and snakes (Wilson & LaVal, 1974; Fischer et al., 2010). Additionally, juvenile bats can be predated upon by cockroaches and spiders (Wilson 1971; Wilson & LaVal, 1974). Wilson and LaVal (1974) reported that predators of *M. nigricans* may include snakes of the genus *Pseustes*, a now

defunct genus whose members were reassigned to the genera *Phrynonax* and *Spilotes* (Jadin et al. 2013). However, they did not state the species of *Pseustes* for which there were observations of predation. Herein we report, to the best of our knowledge, the first documented predation event of *S. sulphureus* on *M. nigricans* and provide a compilation of records of other predation events by snakes that have been observed under the roofs of human habitations in neotropical environments.

At 10:16 h on May 23 2022, at the Manu Learning Centre Biological Station, situated in the buffer zone of the Manu National Park, Madre de Dios, Peru (12.78946° S, 71.39162° W, WGS 84; 460 m a.s.l.), we heard the fluttering of bats coming from inside the thatched roof of the station offices, which is made up of two layers. The inner material is made of layered dried palm leaves and the outer of asbestos sheets. Upon inspection, we noticed an adult *S. sulphureus* (~2,000 mm total length) emerging from a gap in the palm leaves of the roof with a bat in its mouth (Fig. 1). The bat was identified as *M. nigricans*. At 10:32 h the snake moved onto one of the wooden



Figura 1. *Spilotes sulphureus* alimentándose de *Myotis nigricans* en el techo de la Estación Biológica Manu Learning Centre, Madre de Dios, Perú. Foto: Renato W. Colan-Rodríguez.

Figure 1. *Spilotes sulphureus* feeding on *Myotis nigricans* in the roof of the Manu Learning Centre Biological Station, Madre de Dios, Peru. Photo: Renato W. Colan-Rodríguez.

beams supporting the roof where it continued ingesting the bat. Finally, the snake finished consuming its prey at 10:52 h. At 11:00 h, it retreated into the roof and disappeared from our sight. In addition to this predation event, we have observed different *S. sulphureus* individuals moving in and out of the station roofs on multiple occasions.

To complement our observation, we conducted a review of the published literature and compiled a list of 10 records of successful or attempted predation events by snakes within roofs of human structures in the Neotropics (Table 1). The prey species were bats in eight of the records, while the remaining observations involved a lizard and a boid snake.

To our knowledge, this is the first documented record of *S. sulphureus* predating on *M. nigricans*. Black *Myotis* bats live in large numbers in the roofs of buildings at the study site, and *S. sulphureus* is also frequently found in the same roofs, often active during the mornings. Furthermore, due to the large overlap in their distributions and occurrence in similar microhabitats, it is likely that interactions between the two species are not uncommon. Refuges of molossid and vespertilionid bats generally have few openings (Esbérard & Vrcibradic, 2007), which acts as an advantage for snakes that enter them to capture bats. Furthermore, groups of *M. nigricans* are known to remain

lethargic until mid-morning (Wilson, 1971) which would increase the hunting success of predators during the morning as we saw in this predator-prey interaction. Previously, *S. sulphureus* has been documented preying upon the bat *Molossus molossus* in a roof of a house (Rufino & Bernardi, 1999), and entering a roof known to contain a large colony of *Molossus rufus* on multiple occasions (Esbérard & Vrcibradic, 2007).

Our record of predation and habitat use in *S. sulphureus*, along with other published accounts (Rufino & Bernardi, 1999; Esbérard & Vrcibradic 2007), indicates that it is likely that this species utilises roofs of human habitations as a hunting strategy due to the abundance of bats as potential prey, as has been reported for *Chlorosoma viridissimum* (Chávez-Arribasplata et al., 2016), *Corallus annulatus* (Lewis et al., 2009), *Philodryas olfersi* (Barros et al., 2015), *Pseudoelaphe flavirufa* (Rainwater & Platt, 1999) and *S. pullatus* (Esbérard & Vrcibradic, 2007).

Snakes play an important role in the ecosystem as predators in middle and higher trophic levels and provide ecosystem services to humans such as biological pest control. The value of snakes as pest controllers lies in the maintenance of pest populations that are potentially harmful to ecosystems or human health, such as rodents and bats (Mittermeier et al., 1992; Noor, 1995). These groups have been shown to be potential natural reservoirs

Tabla 1. Registros de eventos e intentos de depredación por serpientes en techos en el Neotrópico.

Table 1. Records of snake predation or attempted predation events in roofs in the Neotropics.

Species	Prey	Species of the record	Region	Author
<i>Chlorosoma viridissimum</i>	Bat	<i>Molossus molossus</i>	Madre de Dios, Peru	Chávez-Arribasplata et al., 2016
<i>Clelia clelia</i>	Snake	<i>Boa constrictor</i>	Kartabo, Guyana	Beebe, 1946
<i>Corallus annulatus</i>	Bat	<i>Rhynchonycteris naso</i>	Limón, Costa Rica	Lewis et al., 2009
<i>Cubophis cantherigerus</i>	Lizard	<i>Anolis equestris buidei</i>	Matanzas Province, Cuba	Rodríguez-Cabrera et al., 2016
<i>Philodryas olfersi</i>	Bat	<i>Histiopus velatus</i>	Rio Grande do Sul, Brazil	Barros et al., 2015
<i>Pseudoelaphe flavirufa</i>	Bat	<i>Rhogeessa tumida</i>	Belize	Rainwater & Platt, 1999
<i>Pseudoelaphe flavirufa</i>	Bat	<i>Myotis</i> sp.	Belize	Rainwater & Platt, 1999
<i>Spilotes pullatus</i>	Bat	<i>Molossus rufus</i>	Rio de Janeiro, Brazil	Esberard & Vrcibradic, 2007
<i>Spilotes sulphureus</i>	Bat	<i>Molossus molossus</i>	Pará, Brazil	Rufino & Bernardi, 1999
<i>Spilotes sulphureus</i>	Bat	<i>Myotis nigricans</i>	Madre de Dios, Peru	This study

of many zoonotic viruses as well as contaminating human residences with their faeces (Luis et al., 2013; Nieto-Rabiela et al., 2019). In the records we found, the majority involve non-venomous snakes, or at least those not of medical significance, while the most common prey species are bats. Therefore, the presence of these snakes in human residences may potentially be highly beneficial, acting as domestic pest controllers, while posing relatively low risk to humans.

Our observation highlights how anthropogenic habitats may provide unique feeding opportunities and how some species of snakes have adapted to utilise them. Given the limited literature on this topic, we encourage further documentation of such predation events to shed more light on the ecological roles of snakes, particularly within anthropogenic environments such as the roofs of human habitations, and their impact on pest populations.

Acknowledgements. – We are grateful to Quinn Meyer, owner and Juan Carlos Cárdenas, General Manager of Crees Manu and their team for providing support in the biodiversity surveys at the Manu Learning Centre Biological Station. We thank Edgar L. Marquina-Montesinos for reviewing the first draft of this manuscript. We are also grateful to Pablo J. Venegas for providing comments and suggestions that greatly improved this manuscript.

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